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WHAT IS CLAIMED IS:

1. A system for producing a raster-type laser scanning pattern for scanning 2-D bar code symbols, said system comprising:

a housing;

a light source disposed in said housing, for producing a light beam having cross-sectional characteristics suitable for scanning a 2-D bar code symbol bar code symbol;

a first light beam scanning mechanism, disposed in said housing and responsive to a first control signal, for scanning said light beam along a first reference direction using a first scanning element;

a second light beam scanning mechanism, disposed in said housing and responsive to a second control signal, for scanning said light beam along a second reference direction orthogonal to said first reference direction using a second scanning element, so as to produce a scanning pattern for scanning said 2-D bar code symbol;

light collecting means disposed in said housing, for collecting light reflected off a bar code symbol scanned by said scanning pattern;

light detecting means disposed in said housing, for detecting said collected light and producing scan data indicative of the intensity of said detected light; and

scanning mechanism control means, disposed in said housing, for electrically controlling the operation of said first and second scanning elements so as to produce a raster-type scanning pattern for scanning said 2-D bar code symbol.

2. The system of claim 1, wherein said scanning mechanism control means electrically controls said first and second scanning elements in a synchronous manner so that said raster-type scanning pattern as a whole is substantially free of movement relative to said housing.

3. The system of claim 1, wherein said scanning mechanism control means electrically controls said first and second scanning elements in an asynchronous manner so that said raster-type scanning pattern as a whole moves back and forth along relative to said housing so as to improve the scanning of said 2-D bar code symbol when supporting said housing within the hand-of an operator.

4. The system of claim 1, wherein said light beam is a laser beam.
5. The system of claim 1, wherein said housing is hand-supportable.
6. The system of claim 1, wherein said housing is body-wearable.
7. The system of claim 1, said scanning pattern is a 1D scanning pattern.
8. The system of claim 1,
wherein said first reference direction is along the x axis direction of the system and said second reference direction is along the y axis direction of the system;
wherein said first light beam scanning mechanism comprises a first electromagnetically driven coil for driving said first scanning element, and said second light beam scanning mechanism comprises a second electromagnetically driven coil for driving said second scanning element; and
wherein said scanning mechanism control means comprises a electronically-controlled potentiometer for producing a y-axis drive voltage signal having periodically incrementing and decrementing characteristics, for driving said second scanning element along said y axis direction.
9. The system of claim 8, wherein said scanning mechanism control means comprises means for generating a plurality of y-axis drive voltage signals, each for driving said second scanning element at a different scan rate.
10. The system of claim 8, wherein said scanning mechanism control means further comprises a push-pull type drive circuit for producing a x-axis drive voltage signal having a periodic characteristics, for driving said first scanning element along said x axis direction.
11. The system of claim 10, wherein said y-axis drive voltage signal increments in small quantized voltage level steps, the x-axis drive voltage signal generated independently from said x-axis drive voltage signal.
12. The system of claim 10, wherein said first scanning element comprises a first mechanically-damped scanning element supported at one end from a first

fixed anchoring structure, and driven in an off-resonant manner by said first electromagnetically driven coil; and wherein second scanning element comprises a second mechanically-damped scanning element supported at one end from a second fixed anchoring structure, and driving in an off-resonant manner said second electromagnetically driven coil.

13. The system of claim 12, wherein said first fixed anchoring structure and said second fixed anchoring structure are provided on a common support platform, in close proximity with each other.

14. The system of claim 13, wherein said common support platform comprises an optical bench.

15. The system of claim 1, wherein said housing is a miniature enclosure that can be supported on the hand of an operator.

16. A method of automatically producing a raster-type scanning pattern, comprising the steps of:

(a) producing a light beam having cross-sectional characteristics suitable for scanning said 2-D bar code symbol;

(b) scanning said light beam along a first reference direction using a first light beam scanning mechanism responsive to a first control signal and having a first scanning element;

(c) scanning said light beam along a second reference direction orthogonal to said first reference direction using a second light beam scanning mechanism responsive to a second control signal and having a second scanning element, so that a scanning pattern is produced for scanning said 2-D bar code symbol;

(d) collecting light reflected off a bar code symbol scanned by said scanning pattern;

(e) detecting said collected light and producing scan data indicative of the intensity of said detected light; and

(f) processing said scan data to determine the data in said scanned 2-D bar code symbol, and produce control data indicative thereof;

(g) electrically controlling said first and second scanning elements so as to produce a 2-D raster-type scanning pattern having a number of scan lines

proportional to the number of rows determined in said scanned 2-D bar code symbol.

5 17. The method of claim 16, wherein during step (c) said scanning pattern is a 1D scanning pattern, and during step (g) said 2-D scanning pattern is a raster-type 2-D scanning pattern.

10 18. The method of claim 16, wherein during step (c) said scanning pattern is a raster-type 2-D scanning pattern having a first number of scan lines, and during step (g) said raster-type 2-D scanning pattern has a second number of scan lines which is greater than said first number of scan lines.

15 19. A system for automatically producing a raster-type scanning pattern having a number of scan lines matched to the number of rows of data contained in a 2-D bar code symbol being scanned, said system comprising:

a housing;

a light source disposed in said housing, for producing a light beam having cross-sectional characteristics suitable for scanning said 2-D bar code symbol bar code symbol;

20 a first light beam scanning mechanism, disposed in said housing and responsive to a first control signal, for scanning said light beam along a first reference direction using a first scanning element:

25 a second light beam scanning mechanism, disposed in said housing and responsive to a second control signal, for scanning said light beam along a second reference direction orthogonal to said first reference direction using a second scanning element, so as to produce a scanning pattern for scanning said 2-D bar code symbol;

light collecting means disposed in said housing, for collecting light reflected off a bar code symbol scanned by said scanning pattern;

30 light detecting means disposed in said housing, for detecting said collected light and producing scan data indicative of the intensity of said detected light; and

35 scan data processing means disposed in said housing, for processing said scan data and determine the number of rows of data in said scanned 2-D bar code symbol, and produce control data indicative thereof;

scanning mechanism control means, disposed in said housing and responsive to said produced control data, for electrically controlling said first

and second scanning elements so as to produce a raster-type scanning pattern having a number of scan lines proportional to the number of rows determined in said scanned 2-D bar code symbol.

5 20. The system of claim 19, wherein said number of scan lines is at least two.

21. The system of claim 19, wherein said light beam is a laser beam.

10 22. The system of claim 19, wherein said housing is hand-supportable.

23. The system of claim 19, wherein said housing is body-wearable.

24. A bar code symbol reading system comprising:

15 a hand-supportable bar code symbol reading device which embodies an electronically-controlled laser scanning mechanism for producing a raster-type laser scanning pattern in either a hands-free or hands-on mode of operation for scanning 1-D and 2D bar code symbols.

20 25. The bar code symbol reading system of claim 24, wherein a support stand is provided for supporting said hand-supportable bar code symbol reading device above a counter-top or like surface during said hands-free mode of operation.

25 26. The bar code symbol reading system of claim 25, wherein said hand-supportable bar code symbol reading device can be used as either a portable automatic hand-supported bar code symbol reader in said hands-on mode of operation, or as an automatic fixed projection-type bar code symbol reader in said hands-free mode of operation.

30 27. The bar code symbol reading system of claim, wherein said electronically-controlled laser scanning mechanism comprises:

 a high-speed/high-resolution raster scanning mode of operation during which a high-speed, high-resolution raster-type scanning pattern is precisely generated under electronic control; and

35 a high-speed/low-resolution raster scanning mode of operation during which a high-speed, low-resolution raster-type scanning pattern is precisely generated under electronic control.

28. The bar code symbol reading system of claim 27,

wherein said electronically-controlled laser scanning mechanism is induced into said high-speed/high-resolution raster scanning mode of operation when said hand-supportable bar code symbol reading device is removed from said support stand; and

wherein said electronically-controlled laser scanning mechanism is induced into said high-speed/low-resolution raster scanning mode when said hand-supportable bar code symbol reading device is placed into said support stand.

29. The bar code symbol reading system of claim 28, wherein 2-D bar code symbols can be easily read in said hands-on mode of operation when said electronically-controlled laser scanning mechanism is induced into said high-speed/high-resolution raster scanning mode of operation.

30. The bar code symbol reading system of claim 28, wherein 2-D bar code symbols can be easily read in said hands-free mode of operation when said electronically-controlled laser scanning mechanism is induced into said high-speed/low-resolution raster scanning mode of operation.

31. The bar code symbol reading system of claim 24, wherein 2-D bar code symbols, containing numerous lines of information encoded in accordance with the PDF 147 symbology, can be read by said bar code symbol reading device and the symbol character data representative thereof be automatically transmitted to a base unit over a one-way wireless radio-frequency (RF) link, and therefrom, onto a host computer.

32. The bar code symbol reading system of claim 31, wherein said base unit automatically generates an acoustical acknowledgment signal for reception by the human operator.

33. The hand-supportable bar code symbol reading device is provided with an IR-based object detection subsystem for enabling automatic actuation of said electronically-controlled laser scanning mechanism upon automatic detection of an object.

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34. The bar code symbol reading system of claim 24, wherein said hand-supportable bar code symbol reading device is provided with a manually-actuated trigger for enabling manual actuation of said electronically-controlled laser scanning mechanism upon automatic detection of an object.

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35. The bar code symbol reading system of claim 24, wherein said electronically-controlled laser scanning mechanism is electronically-reconfigurable to produce a single-line type laser scanning pattern upon manual actuation of an external switch provided on the exterior of the hand-supportable housing of the bar code symbol reading device, or upon reading a predesigned mode-switching bar code symbol, for reading 1-D bar code symbols.

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36. The bar code symbol reading system of claim 24, wherein said electronically-controlled laser scanning mechanism comprises a pair of mechanically-damped off-resonant laser beam scanning elements that are electronically-controlled by a synchronously controlled drive circuit.

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37. The bar code symbol reading system of claim 24, wherein said electronically-controlled laser scanning mechanism comprises a pair of mechanically-damped off-resonant laser beam scanning elements that are electronically-controlled by a asynchronously controlled drive circuit so that the raster laser scanning pattern floats slightly along the y-scanning direction to facilitate reading of 2-D bar code symbols during the hands-on mode of operation.

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38. The bar code symbol reading system of claim 24, wherein said electronically-controlled laser scanning mechanism comprises a pair of mechanically-damped off-resonant laser beam scanning elements, each of which comprises an etched scanning element having a small flexible gap region of closely-controlled dimensions disposed between an anchored base portion and a laser beam deflecting portion.

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39. The bar code symbol reading system of claim 38, wherein the resonant frequency or oscillation of each laser beam deflecting portion relative to the anchored base portion is determined by the closely controlled dimensions of

the flexible gap region set during manufacture.

5 40. The bar code symbol reading system of claim 38, wherein the resonant frequency of oscillation of each scanning element is tuned by adjusting the thickness and width of the flexible gap region.

10 41. The bar code symbol reading system of claim 39, wherein the physical dimensions of the flexible gap region are closely controlled by using chemical-etching techniques during manufacture.

15 42. The bar code symbol reading system of claim 38, wherein each etched scanning element is manufactured by chemically etching a double-sided copper clad sheet consisting of a polyamide base material laminated between ultra-thin copper sheets.

20 43. The bar code symbol reading system of claim 38, wherein a permanent magnet is mounted on the rear surface of each laser beam deflecting portion, and a laser beam deflecting element is mounted on the front surface of the laser beam deflecting portion.

25 44. The bar code symbol reading system of claim 38, wherein said anchored base portion of each scanning element is securely fixed to an optical bench and said laser beam deflecting portion is forced to oscillate substantially away from the natural resonant frequency of said scanning element, by a reversible electromagnet disposed in close proximity to permanent magnetic mounted to the rear surface of said laser beam deflecting portion.

30 45. The bar code symbol reading system of claim 38, wherein the natural harmonic (i.e., resonant) frequency of each laser beam deflecting portion about the anchored base portion is mechanically-damped by adding a thin layer of flexible rubber material to the gap region of the scanning element during manufacture, and the laser beam deflecting portion is forcibly driven by a reversible electromagnet disposed in close proximity to the gap region.

35 substantially away (i.e., off) from the natural resonant frequency of the laser beam deflecting portion.

46. The bar code symbol reading system of claim 38, wherein the steady-state

frequency of oscillation of the laser beam deflecting portion is determined by the frequency of polarity reversal of the electromagnet, which is electronically controlled by the polarity of electrical current supplied to the input terminals of the magnet coil of the reversible electromagnet.

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47. The bar code symbol reading system of claim 38, wherein the angular sweep of each laser beam deflecting element is at least about thirty (i.e., +/- 15 degrees) measured with respect to the point of pivot about said anchored base portion.

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48. The bar code symbol reading system of claim 38, wherein electronically-controlled laser scanning mechanism comprises an ultra-compact housing having integrated stops for delimiting the sweep that said scanings element are permitted to undergo during operation.

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49. A bar code symbol reading system comprising:

a hand-supportable bar code reading device having a laser scanning mechanism for generating high-speed raster-type laser scanning patterns for reading one-dimensional and two-dimensional bar code symbols in hands-on and hands-off modes of operation.

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50. A bar code symbol reading system comprising:

a portable data terminal capable of producing either a 1-D or 2-D laser scanning pattern by manual selection, or bar code symbol programming, for reading 1-D or 2-D bar code symbols, respectively.

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51. A bar code symbol reading system comprising:

a hand-supportable bar code reading device has a hands-on high-speed/high-resolution mode of raster scanning, and a hands-off high-speed/low-resolution mode of raster scanning.

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